Air Traffic Operational Evaluation Plan for the Prototype Airport Surveillance Radar Wind Shear Processor (ASR-WSP) at Orlando International Airport

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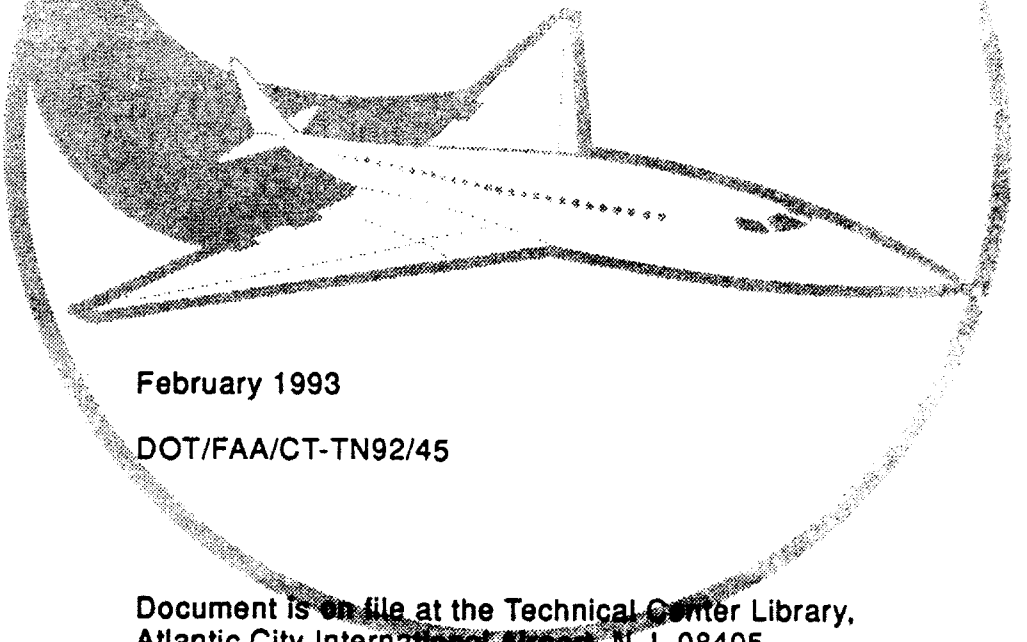

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16. Abstract

The Airport Surveillance Radar Wind Shear Processor (ASR-WSP) (also known as Airport Surveillance Radar-9 (ASR-9) modification for low altitude wind shear detection) is a production ASR-9 with an expanded weather channel for added processing capabilities. The primary mission of the ASR-WSP is to enhance the safety of air travel through the timely detection and reporting of hazardous wind shear in and near the terminal approach and departure zones of the airport. It will also improve the management of air traffic (AT) in the terminal area through the forecast of precipitation, and ultimately the detection of other hazardous weather phenomena.

The ASR-WSP may be used as a stand-alone system at airports without a Terminal Doppler Weather Radar (TDWR) or Enhanced-Low Level Wind Shear Alert System (E-LLWAS), or in an integrated mode with either, or both, the TDWR and E-LLWAS.

This plan outlines the Federal Aviation Administration's (FAA) operational evaluation of an ASR-WSP which will operate at Orlando International Airport (MCO) during the summer of 1992. Data will be collected via questionnaires completed by air traffic controllers and supervisors. The results of the evaluation will be analyzed and any necessary changes will be made prior to full production.

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EXECUTIVE SUMMARY

This plan describes the air traffic (AT) operational evaluation of a prototype Airport Surveillance Radar Wind Shear Processor (ASR-WSP) at Orlando International Airport.

The ASR-WSP is a production Airport Surveillance Radar (ASR-9) with an expanded weather channel for added processing capabilities. Its primary mission is to enhance the safety of air travel through the timely detection and reporting of hazardous wind shear in and near the terminal approach and departure zones of the airport.

The evaluation will pay particular attention to the following areas: (1) man-machine interface, (2) timeliness and/or system response rate, and (3) integration with existing systems. Air traffic controllers and supervisors were asked to answer a detailed questionnaire designed to allow them to voice their opinions and recommendations on the system. The results of the evaluation will be analyzed and any necessary changes will be made prior to full production.

PURPOSE

The purpose of this plan is to describe the air traffic (AT) operational evaluation of a prototype Airport Surveillance Radar Wind Shear Processor (ASR-WSP) at Orlando International Airport (MCO). The testing will be held from June 29 to August 31, 1992.

The ASR-WSP (also known as Airport Surveillance Radar-9 (ASR-9) modification for low altitude windshear detection) is a production ASR-9 with an expanded weather channel for added processing capabilities. The primary mission of the ASR-WSP is to enhance the safety of air travel through the timely detection and reporting of hazardous wind shear in and near the terminal approach and departure zones of the airport. It will also improve the management of AT in the terminal area through the forecast of precipitation, and ultimately the detection of other hazardous weather phenomena.

The ASR-WSP may be used as a stand-alone system at airports without a Terminal Doppler Weather Radar (TDWR) or Enhanced-Low Level Wind Shear Alert System (E-LLWAS), or in an integrated mode with either, or both the TDWR and E-LLWAS.

REFERENCE DOCUMENTS

FAA-E-2806a	Terminal Doppler Weather Radar (TDWR) Specification
DOT/FAA/PM-87-23	Microburst Detection Algorithm
DOT/FAA/PM-87-24	Gust Front/Wind Shift Detection Algorithm
ER/300-87-08-001	Terminal Doppler Weather Radar Product Output Formats
FAA-E-270	Airport Surveillance Radar-9 Specification
FAA-STD-024a	Preparation of Test and Evaluation Documentation
FAA Order 1810.4b	NAS Test and Evaluation Policy
MIT/LL	Airport Surveillance Radar Wind Shear Processor: 1991 Test at Orlando, Florida
CN240-92-01	A Quick Look Report for the 1991 Demonstration and Operational Test and Evaluation of the Airport Surveillance Radar Wind Shear Processor(ASR-WSP) at Orlando International Airport in Orlando, Florida
XXXX-XXX	Draft ASR-WSP Specification
DOT/FAA/NR-91/1	The 1990 Airport Surveillance Radar Wind Shear Processor (ASR-WSP) Operational Test at Orlando International Airport

EVALUATION PHILOSOPHY

Since 1986, the ASR-9 program office (ANR-200) has sponsored Lincoln Laboratory (LL) to evaluate the low-altitude wind shear detection capabilities (such as microbursts and gust fronts) of the ASR-9. This capability may be achieved by means of a relatively low cost modification to existing ASRs which would allow them to detect low-altitude wind shear without interfering with their primary function of aircraft detection and tracking. An ASR-WSP test bed operated in Huntsville, Alabama in 1987, and 1988, in Kansas City, Missouri in 1989, and most recently in Orlando, Florida, in 1990, 1991, and 1992. During the Orlando demonstration, the ASR-WSP utilized the TDWR display devices providing essentially the same products as those provided by the TDWR. Lincoln Laboratory's TDWR test bed and two additional doppler radars, one operated by the University of North Dakota (UND) and the other by Massachusetts Institute of Technology (MIT) Weather Radar Laboratory, provide independent measurements to support verification. The MIT/LL TDWR, UND, and MIT operate in the C-band. The ASR-WSP is an S-band radar.

The operational evaluation of the ASR-WSP by MCO air traffic control specialists (ATCS) and supervisors is designed to ensure that in this developmental phase of the system AT recommendations are incorporated into the specification. It provides the FAA the opportunity to determine how the controllers feel about the system and what can be done to improve it prior to the production phase.

The evaluation will pay particular attention to the following areas: (1) man-machine interface, (2) timeliness and/or system response rate, and (3) integration with existing systems; mainly, with LLWAS-3.

EVALUATION APPROACH

The AT operational evaluation will be conducted at the end of MIT/LL prototype testing at Orlando International Airport in Orlando, Florida. Air traffic controllers and supervisors will be requested to answer a detailed questionnaire designed to allow them to voice their opinions and recommendations on the system. Following the evaluation, the completed questionnaires will be analyzed by ACW-200D at the Federal Aviation Administration (FAA) Technical Center. If considered necessary or more information is needed, followup interviews will be conducted. The analyzed data will be published in a final report which, in turn, will be forwarded to the principal organizations supporting the ASR-WSP program for incorporation into the production specification.

EQUIPMENT

Airport Surveillance Radar-9 (ASR-9). The ASR-9 is the first airport surveillance radar that can display both weather and aircraft simultaneously. This S-band radar features a dual-channel design capable of tracking both aircraft and up to six levels of weather. The weather channel can be modified to allow low level wind shear detection, which is the subject of MIT/LL testing.

The following equipment (TDWR displays) will be located at the tower cab (one Geographical Situation Display (GSD), two large Ribbon Display Terminal ((RDTs), one small RDT), Terminal Radar Approach Control (TRACON) (one GSD, one large RDT), and the training room (one GSD, one large RDT):

Ribbon Display Terminal (RDT). The RDTs function as integrated readout devices retaining the LLWAS runway threshold and center field wind data, and providing alarms on ASR-WSP microburst (MB) detections near or on the runways and in the approach and departure areas. This information is provided to air traffic control (ATC) in alphanumeric format. Two sizes are being used; a 12" x 11.25" x 6" (small size) and a 15" x 15" x 6" (large size).

Geographical Situation Display (GSD). The GSD uses a Sun workstation to display weather information to ATC supervisors and controllers. It functions as a situation display monitor and as an AT planning tool for runway management. This color workstation provides graphical representation of the location and intensity of precipitation, MB and gust fronts (GF), as well as estimates of the speed and direction of motion for precipitation cells and gust fronts.

ORGANIZATIONAL ROLES AND RESPONSIBILITIES

The principal organizations which will be participating in the ASR-WSP evaluation are: (a) FAA ANR-200, (b) FAA Technical Center, ACW-200D, (c) Orlando ATC and Air Facilities (AF) (MCO), (d) MIT/LL, and (e) University of North Dakota (UND).

RESPONSIBILITIES.

FAA Terminal Radar Program (ANR-200). ANR-200 has the overall responsibility for the ASR-WSP program. This office is responsible for the coordination of National Airspace System (NAS) Change Proposals (NCPs), Notice to Airmen (NOTAMs), and Memorandums of Agreement/Memorandums of Understanding (MOA/MOU) with participating organizations.

FAA Technical Center - ACW-200. The Technical Center Weather and Primary Radar Division (ACW-200) has been designated as the Associate Program Manager for Testing (APMT) and will provide a test director who will be responsible for the logistics, scheduling, and coordination between AF, AT, MIT/LL, UND, and other agencies as required. ACW-200D will prepare questionnaires, analyze controller's responses and prepare a final operational evaluation report. It will also prepare a monitoring report, administer briefings when necessary, and review MIT/LL's final report.

Orlando Airways Facilities (AF). Airways Facilities will provide workspace at the ATC tower for MIT's test coordinator. It will install headset jacks at the ATC tower cab meteorological position (if a meteorologist is required at the tower) for reception of both arrival and departure frequencies. It will also install signal lines between the ATC tower cab and the equipment room as specified by LL.

Orlando Air Traffic (AT). Air Traffic will provide supervisors and controllers participants for the operational evaluation during the test period. It will provide a point of contact for coordination during the test period. By agreement, MCO, a Plans and Procedures Specialist (PPS), will brief controllers and administer questionnaires.

Massachussets Institute of Technology Lincoln Laboratory (MIT/LL). Lincoln Labs will provide a test coordinator, ASR-WSP radar displays, technical personnel, and work stations in the MIT/LL trailer at the radar site to:

1. Monitor the quality of the radar's base data (reflectivity, spectrum width, and velocity products).

2. Monitor the status of the software computations and Key Signal Processing System systems.

3. Assess the weather data and graphical output products generated by the software.

4. Provide software for MB detection and prediction, gust front detection and prediction, and storm movement. Provide real-time entry of wind shear event locations for subsequent scoring.

5. Provide displays that will include two Digital Equipment Corporation (DEC) monitors (model VT-240), a Videotek color monitor (model Cd-19HR) and several Sun work stations. The color monitors and work station displays will have the ability to display base product data with or without the graphical output from the MB/gust front detection and wind shift prediction functions.

6. Provide GSD and RDT for ACW-200 and other observers at the site and for controllers to use at the tower cab and TRACON.

7. Participate in data reduction team as members of the radar truth scoring team.

8. Daily weather reports and GSD pictures of selected events will be forwarded to the test director when requested. They will obtain recordings of the tower's local control communication channels for those periods when MB advisories are issued and for at least one period when a strong gust front approaches and passes over the airport. The MIT/LL will provide a final evaluation report to ANR-200.

UNIVERSITY OF NORTH DAKOTA (UND). The UND will provide a second doppler radar coverage for the ASR-WSP coverage sector, provide logs of significant weather events to assist in the analysis of the ASR-WSP data, provide logs and recorded doppler data for resolving missed wind shear events, participate in radar truth scoring team, and monitor the status of the software computations and Key Signal Processing System systems.

ROLES.

TEST DIRECTOR. The test director is responsible for the overall management and direction for the ASR-WSP prototype testing and provides management guidance through the test team. The test director is also responsible for conducting pretest and post-test briefings, writing the operational evaluation report and the collection of all applicable data for subsequent analysis.

TEST MANAGER. The test manager is responsible for the monitoring of the test, collection of data from ATC for the operational evaluation, and writing a final report.

DOCUMENT REQUIREMENTS AND CONTROL

The documents listed below are required to plan, describe, conduct, and report the results of the operational evaluation of the ASR-WSP.

AIR TRAFFIC OPERATIONAL EVALUATION PLAN.

This plan describes the requirements, methods, and responsibilities for conducting the ASR-WSP operational evaluation. It will provide a method for the FAA to obtain AT reaction to the usefulness and effectiveness of the ASR-WSP in a live operational environment.

EVALUATION QUESTIONNAIRE.

In order to obtain feedback from the users a questionnaire was developed. The questionnaire is divided into specific areas regarding the RDT and GSD as well as some general aspects of the system. Comments are encouraged. The questionnaire is structured to obtain the evaluation of the ASR-WSP by rating a statement about each feature/function on a five-point scale ranging from very good to very poor, plus a "don't know" category for controllers who did not see a specific feature working, due to lack of weather or some other reason, when they were using the equipment.

DRAFT FINAL REPORT.

Within 30 days following the end of the testing, a draft final report will be submitted to ANR-200 for review.

FINAL REPORT.

After review and editing of the draft final report, the final report will be prepared and will include results, conclusions, problems/issues, and recommendations. This report will be sent to ANR-200 and the participants within 45 days after receiving comments on the draft final report.

TRAINING

The MIT/LL will provide training to the controllers. Training will be held a few weeks before the testing begins. Controllers will be trained to use and understand the ASR-WSP products provided on the GSD and RDT.

EVALUATION SUPPORT REQUIREMENTS

This section describes the instrumentation required for the evaluation and the types of data analysis to be performed.

INSTRUMENTATION.

No special instrumentation is required for the evaluation. The MIT/LL will install and maintain all the necessary equipment (including the radar itself) to send the products to the tower.

DATA ANALYSIS.

Numerical values will be assigned to the questionnaire responses, and then analyzed statistically. The intent of the analysis is to find out which areas receive general positive ratings and which ones do not. Mean scores greater than zero mean that the average response to a particular feature indicated some merit and was considered desirable by ATC. Suggestions and comments will be used to supplement the numerical ratings. Those areas showing low ratings will be discussed in the final report in order to provide recommendations.

REVIEWS AND MEETINGS

The visits, briefings, and reviews described below are necessary to successfully conduct the operational evaluation of ASR-WSP.

PRETEST MEETING.

A meeting will be held with Orlando ATC to discuss the objectives of the evaluation, schedules, and procedures to follow in order to obtain as much participation from ATC without interfering with their normal operations.

SCHEDULE

Installation of ASR-WSP Complete	July 1991
Develop Evaluation Plan	May 1992 - July 1992
Prepare Evaluation Questionnaires	June 1992 - July 1992
ASR-WSP Demonstration Period	July 10 through August 31, 1992
Operational Evaluation Complete	August 31, 1992
Draft Final Report	September 30, 1992
Final Report	45 days following return of comments on draft final report

ACRONYMS AND ABBREVIATIONS

ACW-200	Weather/Primary Radar Division (Technical Center)
AF	Air Facilities
ANR-200	FAA Terminal Radar Program
ASR-WSP	Airport Surveillance Radar Wind Shear Processor
AT	Air Traffic
ATC	Air Traffic Control
ATCS	Air Traffic Control Specialist
DEC	Digital Equipment Corporation
E-LLWAS	Enhanced Low Level Wind Shear Alert System
GF	Gust Front
GSD	Geographic Situation Display
LL	Lincoln Laboratory
LLWAS	Low Level Wind Shear Alert System
MB	Microburst
MCO	Orlando International Airport
MIT	Massachussets Institute of Technology
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
NAS	National Airspace System
NOTAM	Notice to Airmen
PPS	Plans and Procedures Specialist
RDT	Ribbon Display Terminal
TDWR	Terminal Doppler Weather Radar
UND	University of North Dakota

APPENDIX A

ASR-WSP EVALUATION REQUIREMENTS MATRIX

No formal specification exist.

APPENDIX B

OPERATIONAL EVALUATION QUESTIONNAIRE

Tower____ Tracon____ Controller____ Supervisor____ (8/92)

GEOGRAPHICAL SITUATION DISPLAY (GSD)

Please answer question 1 using the following scale:
-2=very poor -1=poor 0=fair 1=good 2=very good ?=do not know.
If you did not work with a specific piece of equipment please skip the corresponding section.

1. Rate the following ASR-WSP features: (Please circle one)

a.	completeness of the displayed information	-2	-1	0	1	2	?
b.	accuracy of the displayed microburst information	-2	-1	0	1	2	?
c.	accuracy of the displayed gust front information	-2	-1	0	1	2	?
d.	timeliness of the displayed information	-2	-1	0	1	2	?
e.	usefulness of the displayed microburst information	-2	-1	0	1	2	?
f.	usefulness of the displayed gust front information	-2	-1	0	1	2	?
g.	usefulness of wind shift prediction	-2	-1	0	1	2	?

2. Please state instances (if any) of wind shear that the system did not display:_____
_____
_____
_____
_____

3. Do you consider the rate of false alarms for microbursts acceptable ?____YES ____NO If NO explain. _____
_____
_____
_____

4. Do you consider the rate of false alarms for gust fronts acceptable ? ____YES ____NO If NO explain. _____
_____
_____
_____

5. Provide comments on any rating of 0 or lower and/or any other comments on the role of the GSDs._____
_____
_____
_____
_____
_____

6. Supervisors only: Was the GSD useful in making runway configuration changes prior to weather events? YES____ NO___. Please explain. _____

_____

_____

_____

RIBBON DISPLAY TERMINAL (RDT)

1. Rate the following features: (Circle one using the following scale: -2=very poor -1=poor 0=fair 1=good 2=very good ?=do not know)

a.	completeness of the displayed information	-2	-1	0	1	2	?
b.	accuracy of the displayed microburst information	-2	-1	0	1	2	?
c.	accuracy of the displayed gust front information	-2	-1	0	1	2	?
	timeliness of the displayed information	-2	-1	0	1	2	?
e.	usefulness of the displayed microburst information	-2	-1	0	1	2	?
f.	usefulness of the displayed gust front information	-2	-1	0	1	2	?
g.	clarity of the displayed information	-2	-1	0	1	2	?
h.	aptness of message abbreviations	-2	-1	0	1	2	?

2. Please state instances (if any) of wind shear that the system did not display:_____

_____

_____

_____

3. Provide comments on any rating of 0 or lower and/or any other comments on the role of the RDTs._____

_____

_____

_____

_____

_____

GENERAL

1. Rate the usefulness of the ASR-WSP for runway management. (Circle one.) -2 -1 0 1 2 ?

2. Do you see the ASR-WSP as a help or a hindrance to you in your job of controlling local traffic? (Circle one)

a. great help b. some help c. neither help nor hindrance
d. hindrance e. great hindrance f. do not know

Any comments? _____

3. What benefits do you see from the ASR-WSP?

4. What problems do you see with the ASR-WSP?

5. Based on your present knowledge, please rate the ASR-WSP's suitability for widespread operational use in the field. Please circle one of the letters.

   a. suitable, install and use, do not make any changes.
   b. suitable, install and use but some changes beneficial.
   c. unsuitable, do not install, some changes necessary prior to installation.
   d. unsuitable, do not install, good concept but extensive redesign necessary.
   e. unsuitable, do not install, entire concept inappropriate.
   f. do not know.

   If you think that changes are necessary please list them.

Please list here any other comments you have.